JUL 2 1913

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXX NO. 26 | SAN FRANCISCO, JUNE 28, 1913 | PER COPY, 25 CENTS

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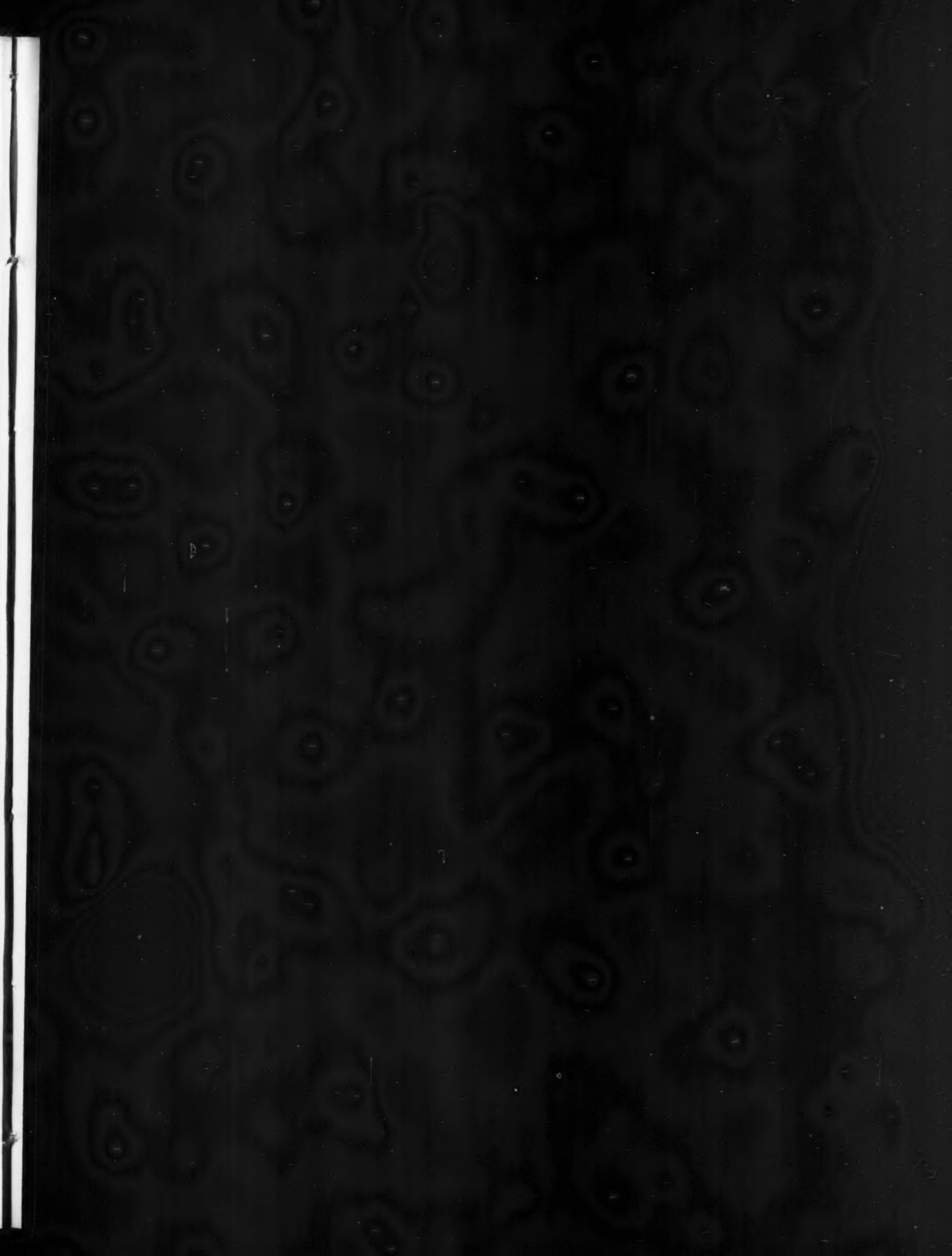

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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXX SAN FRANCISCO, JUNE 28, 1913 NUMBER 26

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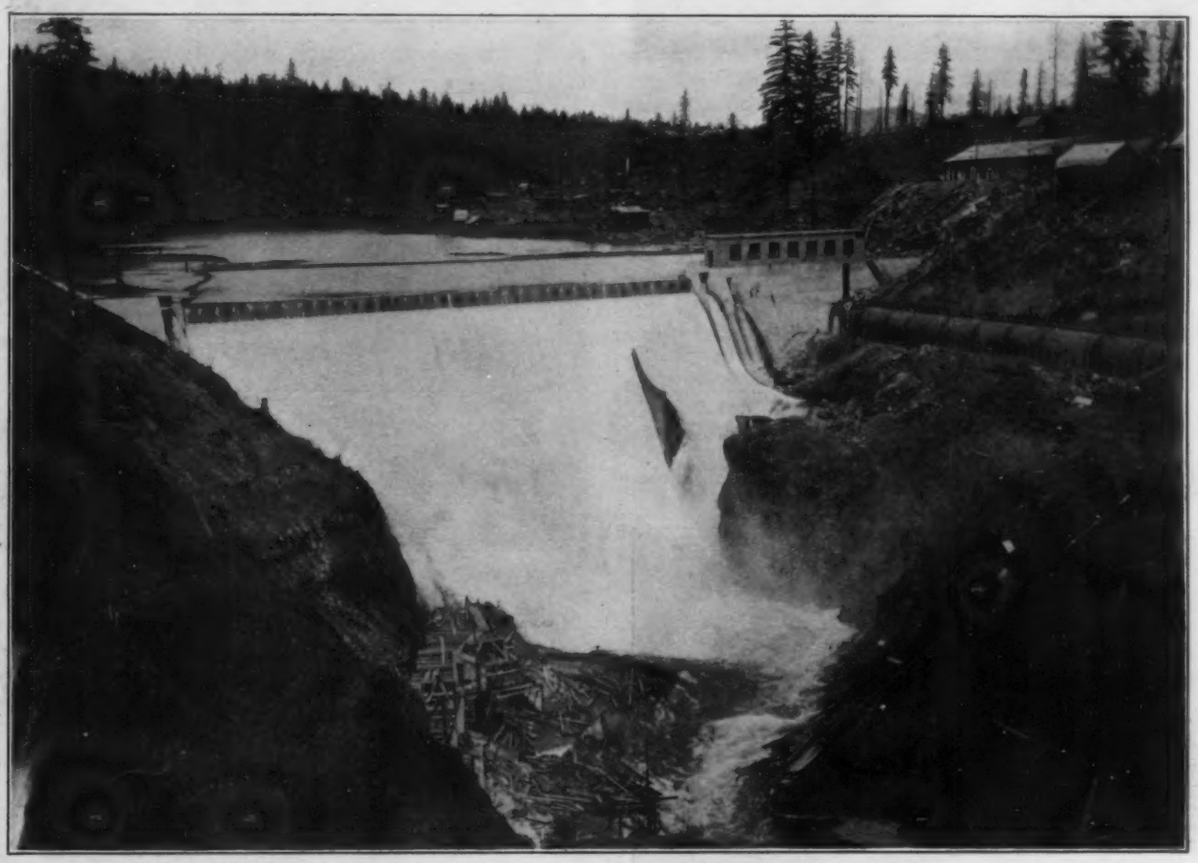
THE WHITE SALMON RIVER DEVELOPMENT

BY WILBUR B. FOSHAY.[1]

The Northwestern Electric Company, a corporation, made up of San Francisco and Portland capitalists, and with the main offices located in Portland, Oregon, has completed and put in operation a power plant on the White Salmon River, at a point about three miles above the point where it empties into the Columbia.



A view of the Dam in the White Salmon River Development.

In order to make this development it was first necessary to construct a road along the hillside from Underwood Station, on the North Bank Railroad, to the site of the proposed power house and dam, a distance of about three miles, and in order to cross the ravine through which the White Salmon River flows, a bridge about 115 ft. long and some 90 ft. above the river was constructed. This bridge had to be constructed strong enough to carry all of the power house equipment, which of a necessity must be hauled over it.

The dam proper is about one mile above the power house site and is constructed between two stone walls of natural formation, being at a point

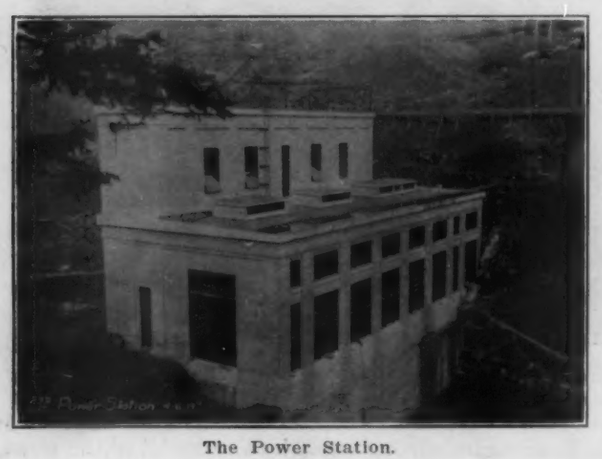
[1]Manager of the Northwestern Electric Company.

where the river flowed through a deep cut. This dam is 60 ft. long at the bottom and 470 ft. at the top. It is 96 ft. through at the bottom and 15 ft. at the top. The height of the dam from bed rock is 125 ft. and the dam contains about 30,000 cu. yds. of concrete. During the construction of this dam there was located on the hillside above the dam site rock crushers and sand machines. The rock was taken with scrapers into the rock crushers and crushed to the proper size, a portion of this rock then going by gravity into the sand machine and

Looking Through the Large Wood Stave Pipe.

being ground into sand. This in turn was carried into the mixer by gravity where cement and water were mixed in with the sand and crushed rock. The concrete thus made was carried by gravity to its proper place in the dam 100 ft. below. In this way after the material entered the rock crusher it was not touched by human hands again, but carried by its own weight through the various processes in troughs to its proper place in the dam.

From the dam site to the power house, one mile below, the water is carried in a wood stave pipe 13 ft. 6 in. in diameter, which pipe is the largest wood stave pipe of which any record can be found. This wood

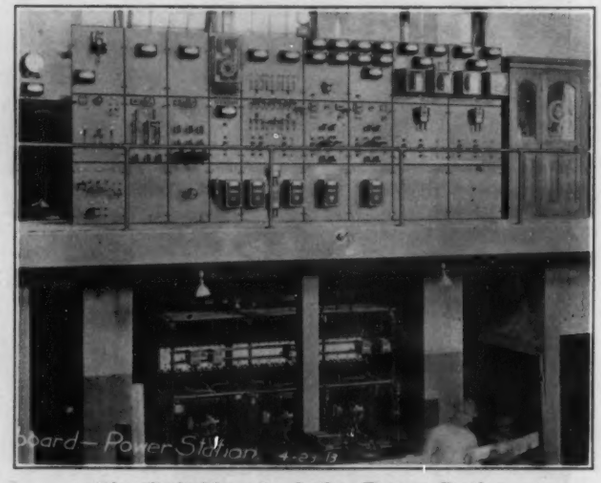


The Power Station.

stave pipe was constructed and installed by the Pacific Coast Pipe Company. This large wood stave flume is constructed on a hydraulic grade the pipe resting in cradles set on concrete foundations, these cradles being about 4 ft. 6 in. apart. At a point about 700 ft. from the power house it is reduced to two nine foot pipes, which at a point some few hundred feet nearer the power house are changed to a steel riveted construction and these steel pipes continue to the power house proper.

The power house itself is located directly on the river bank and a working head of 177 ft. is secured. The power house proper is of concrete and steel construction; the building being approximately 70 by 150 ft.

The water wheels are of the Francis turbine type manufactured by the Allis-Chalmers Company. There are two water turbines to each generator; one turbine being located on each side of the generator. The entire unit made up of the two turbines, and the generators which are Allis-Chalmers machines, are carried on two bearings, one on each side of the generator, the shaft extending through the discharge pipes of the turbines, which are one-quarter turns, and in which are located thrust bearings, so that while these bearings carry no weight in the operating of the units, in case it is necessary, either unit can be taken down and the other unit can operate the generator. Thus during a repair to one turbine unit, only one-half the capacity of the generator will be lost. There are two such installations with a capacity



The Switchboard of the Power Station.

of about 10,000 horsepower each installed in this power plant, and with the generating units made up as explained, the plant can be operated at the greatest efficiency at one-quarter, one-half, three-quarters or full load.

In the same power house are located the transformers for stepping the current up from 2300 volts, at which it is generated, to 60,000 volts for transmission to the city of Portland. The switching apparatus and auxiliaries are also situated in this power plant. The transformers and switching apparatus in this plant was furnished by the General Electric Company.

From this power plant to the river crossing at Camas, the pole line is completed and is in operation to Camas, at which point 4000 horsepower are now being served to the Crown Columbia Paper Mill; this being one of the largest paper mills on the Pacific

Coast. At Camas the pole line will cross the Columbia River, the towers for this line now being in place and completed. The tower crossing consists of five supporting towers and four strain towers, the height of these towers being 140 ft. The material for the construction of this line into the city of Portland has all been ordered, and is in the course of shipment at the present time, as is also the equipment for a steam auxiliary plant to be located in the heart of the city of Portland, in the new Pittock Block, where will also be located the direct current converting station. This steam auxiliary plant will have boiler capacity sufficient to carry the two 3750 kw. General Electric turbines that have been ordered for installation in this plant.

There is now before the city council of Portland, a steam heating franchise of the Northwestern Electric Company, and after the passage of this fran-

Forebay and Pressure Pipe Lines.

chise the company will proceed to install a central steam heating plant, securing the steam from the auxiliary plant herein referred to, and distributing it in the main business sections of the city, it being the idea of the company to install its heating and underground conduit at the same time.

The entire system, including power site, pole line and steam plant in Portland, has been located and designed under the direction of B. C. Condit, a San Francisco engineer. The hydraulic development was made by the Stone & Webster Engineering Corporation, on contract, and was in charge of Mr. J. H. Manning of that company.

STATE AND NATIONAL CO-OPERATION IN THE DEVELOPMENT OF OREGON'S WATER RESOURCES.[1]

BY FRED F. HENSHAW.[2]

A society emerges by slow degrees from the state of barbarism and the lower developments of civilization to the high plane of the civilized state in the twentieth century, it puts to use new agencies to satisfy the many new requirements to its well being. Primitive man may subsist in a forested region dependent on the chase. The more primitive forms of transportation and communication are called upon for service and a few animals are domesticated for man's use. At a later step in his advance comes the use of the land for agriculture. The employment of mechanical power as an aid to development of civilization comes as a relatively late step. Yet beyond a certain point there is hardly any one agency which contributes more largely to man's social well being than the application of mechanical power. Few indeed are the occupations which do not require it in some form. It is essential to the development of transportation, except where horses or other animals are used as a motive power. In our present complicated society mechanical power has become just as essential in agriculture as it is in manufacturing or transportation.

Along with the development of its uses the means of generating and distributing mechanical power have grown apace. Without going back farther than a few decades we have grown from the use of the isolated water power and the inefficient steam engine to the utilization of prime movers of the highest efficiency and the distribution of the power generated by them through scores of hundreds of miles by the aid of high tension electric currents. The present rapid development of long distance transmission of water power dates back hardly more than 20 years, and it has received its most effective impulse from improvements within the last ten.

The problem of the proper governmental policies in regard to the generation and distribution of hydroelectric power have only just been brought forcibly to the attention of the body politic, and yet at present there is almost no question of greater importance. The problem is made more acute, especially in some localities, by the relatively limited amount of the source of primary power, and presents different phases in different portions of the United States. The coal fields of the country appear at present almost limitless in extent and yet, they are not inexhaustible by any means. Scientists tell us that there is a sufficient stock of fuel for perhaps the next 150 years. No one can predict, however, the rate of future growth of power utilization and consequent depletion of the supply of fuel.

In the case of hydraulic power the source of energy is perpetually renewed but in a great many portions of the country the supply of potential water power is limited and even at present could not supply

[1]Read before a joint meeting of the Commonwealth Conference and Oregon Society of Engineers, at the University of Oregon, Eugene, May 17, 1913.

[2]District Engineer, U. S. Geological Survey.

the demand alone. Thus in the central portion of the great Mississippi Valley there is only one power site of large magnitude which has been considered feasible of development at the present time.

On the Pacific Coast the water power resources are relatively most abundant and apparently there will be no need of fully developing them for several decades to come. It has been estimated by the commissioner of corporations that approximately 11,500,000 or 43 per cent of the total estimated potential power of the country is found in the three Pacific Coast States of Oregon, Washington and California. This total, of course includes many powers that are not and may never become commercially feasible. The potential power of Oregon streams has been estimated at over 3 million horse power while the total amount of power used in the State of New York today is probably not over one-third of this amount. Problems of cost of development, distance from market, and interference of high water, serve to make many potential power sites unfavorable for development at the present time, and materially reduce the amount of power actually available. As a matter of practical economy therefore, it is impossible to consider water power resources as by any means unlimited.

The generation and distribution of electric power is a function similar in nature to the supplying of water to a community for domestic use, or the furnishing of transportation by railroad and street car lines. All come under the category of natural monopolies as the service is rendered in connection with the plant itself and cannot be separated from it. The conduct of these natural monopolies for public service is essentially a governmental function, but in the past the government has in most instances seen fit to turn over the actual handling of these to private enterprise.

The supplying of water for irrigation is likewise a public function. The national and state governments were slow to recognize this truth but a little over ten years ago it was accepted as a part of governmental policy and the United States Reclamation Service was organized to actively prosecute the construction of irrigation work. In its relatively short career the Reclamation Service has placed irrigation development on a much higher plane and a much more permanent basis than was the case before its inception.

Private companies engaged in the conduct of a public utility, such as transportation, irrigation, or water power development, must in the nature of things look for direct returns on their capital invested. Most companies cannot afford to wait for a long term of years to see these returns come in. Of course there are notable instances where railways have been built through an undeveloped country with a view to aiding in its development and have not expected to receive adequate returns on their investment for many years to come. The same is true in the case of many power companies which have extended transmission lines into relatively new areas which promised to develop power markets with sufficient rapidity to ultimately more than repay the cost of service. Capital is naturally timid, however, and there are instances where the development of large areas of favorably situated country have been held back for long periods through the failure of private capital to properly look ahead to the future. Were the government engaged in these activities they would not look merely at the direct or immediate returns, but could look ahead to the more distant future and could consider the indirect returns in the increase of taxable wealth and the development of the country as a part of their remuneration for the money spent.

Government control (using the word government in its broad sense to include both state and national), would also be conducive to the highest use of the resources of the State. A power company, when it seeks a site for development, does not question whether the water could be better used for irrigation or whether the use to which they are putting it is the highest. They consider merely its adaptability to their own particular purposes. The question of the relative utility of our water resources is one which will in the future become very pressing. With a well constructed policy on the part of the State, future conflicts of use can be avoided and the ultimate greatest benefit of all served can be attained.

An argument for control by the Federal Government is the desirability of uniform regulation all over the country. Oregon and Wyoming have water laws which probably represent the highest degree of development in this country. Many states have systems of water titles which are much less perfect. In some of them the water rights are nothing short of chaotic. This is decidedly the case in Washington, for instance. Uniform regulations would work to the special advantage for such states. All complications arising on international streams, must of necessity be handled through the federal authorities.

Thus far the activities of the State and Federal Governments, so far as they have been turned to power development, have merely sought its regulation. Neither governmental agency has a free field in the control. The states at present control the rights in and the distribution of the water within their borders and many, like Oregon, have by legislative enactment provided a code of water laws. Most lands that have not yet passed into private ownership are still retained by the United States. The Federal Government also exercises control over navigable waterways, and as a necessary part thereof, appears to hold some measure of control over the non-navigable tributaries of these streams. Most of the states have sought to establish some degree of regulation over power development. In Oregon this is provided for in the water code by the provisions of which parties desiring to develop power must secure the permission of the State authorities.

The control of the Federal Government over power development has been exercised in two ways—first, by requiring that permission shall be secured for its development on navigable streams. Such permission is granted by a special act of congress and the development is then under the general control of the Secretary of War. In the case of power development on the public lands and reservations of the United States the Federal Government acts in the role of landlord. The statutes provide for the granting of rights-of-way for the construction of irrigation works which are in the nature of easements. For the development of power a permit is granted which, under the present enactment, is

revokable at the will of the Secretary. Under this law, generally known as the Act of 1901, the Secretary of the Interior, and the Secretary of Agriculture have issued regulations for power development on the public lands and in the forest reserves respectively which are essentially identical. These regulations provide for the issuance of permits which shall terminate at the expiration of 50 years unless previously revoked and the payment by the permittee of a nominal compensation for the use of the power site. This charge increases gradually from year to year and is made smaller for power sites which require long transmission lines to centers of distribution. These regulations provide for the revaluation of the permit at the end of each ten years and readjustment of the rates charged.

In the consideration of the question of the proper charges for the use of public power sites it would appear that the basis of the charge might be taken as the rental value of the site. The economic law of rent applies to water powers just as truly and with many of the same limitations as it does to land. The rental value of a water power site is measured by the difference in cost of developing power at that site and at the next site which must be utilized to supply the market, or the difference between the cost of development at the site and from fuel. As the demand for power increases and as other and still less favorable power sites must be used the rental value of any particular site increases just as the value of land increases. It has been proposed by some political economists to make this increment a basis of taxation. At any rate, it would seem that the charges for the use of power sites owned by the public and leased to private corporations should ordinarily be limited by the rental value of the site. It has been contended that the imposition of such a tax would tend to place the burden of its payment upon the consumer of power and that its removal would tend to decrease power rates. The laws of economics teach us that this is not the case. If the rent is remitted it is in the nature of a gift and it would be very difficult to force the power company to pass the gift on to the consumer.

The selling price of power may be divided into three component parts—first, the cost of actual delivery of the power at the switchboard of the station, which may be called the generating charge; second, the cost of distributing; and third the commercial charge which includes the maintenance of the power companies organization; the accounting of collection departments and similar expenses. For the bulk of the power sold especially for lighting, the distributing and commercial costs are greater than the generating cost. The rent of the power will be added to the generating cost and in general will be lost in the greater amount of the commercial charges, and will have little if any effect on rates. For power in large quantities the rental charge is relatively larger in proportion to the selling price.

Thus far I have been discussing particularly the situation in regard to water power development. Closely allied with the developments of water power and of fully as great interest to the people of the State as a whole are the proper conduct of irrigation works and the policy which will conduce to their highest utility.

It has been estimated by the conservation commission that, leaving out of consideration Columbia River and the streams of the Coast Range, the rivers of Oregon discharge annually about 40,000,000 acre-feet of water and that of this amount practically 9,000,000 can be ultimately utilized on the land for irrigation. This will mean at least 3,000,000 acres of land brought under cultivation. A large percentage of this land is now of little use for agriculture and the productivity of all will be increased many fold by the application of water. In 1909 the census returns showed that there were actually under irrigation in Oregon pratically 700,000 acres, probably including large areas of land partially watered, and this area has no doubt been increased considerably since that date. Practically 60 per cent of this has been watered by small ditches constructed by individual and partnership enterprises, and generally watering land in the immediate vicinity of a stream without the aid of extensive engineering works such as storage reservoirs, diversion dams and long canals. The possibilities of additional irrigation on this scale are limited and further development must come by the building of large projects, of tens, or even hundreds of thousands of acres. Many such projects have been taken up in the past by private companies and under the provisions of the Carey Act.

Of the various projects which have been undertaken by the State, under the Carey Act, a number have either foundered on financial rocks or at least, have been reorganized, often more than once. These difficulties have generally been due, according to the Oregon Conservation Commission, to one or all of five causes:

1. An unduly heavy initial incubus upon the project, for promotion and organization expenses;
2. Inadequacy of the water supply;
3. Lack of complete engineering plans and reliable estimates of cost;
4. Lack of adequate financial backing;
5. Inexperience and mismanagement in handling the enterprise and colonizing the land on the part of both promoters and State officials.

It is not likely that the same mistakes will be made to the same extent in future work. There are, however, certain inherent difficulties in the way of successful irrigation development on a large scale by private capital. The returns on the original investment are necessarily slow in coming in, possibly two to five years are needed in gathering stream flow and other engineering data, and two or three years more are occupied by construction work before the payments by the settler begin. The land may be settled up slowly, in most large projects this has been the case, and altogether it may be two or three decades before the original investment is repaid. In the meantime the interest charges on a commercial project must be paid promptly or the developing company will be thrown into the hands of receivers. In any event, capitalists are not eager to undertake to finance construction if they must wait so long for returns on their outlay. In the ordinary mercantile business, the total capital may be

turned over perhaps twice in a year, each time with profit. Experience has proven that capitalists are not willing to wait so long a time for returns on their outlay. In a mercantile business the total capital may be turned over perhaps twice in a year, each time with profit. Even in the case of a railway, which is much more nearly analogous to an irrigation project, the net earnings may reasonably be expected to pay dividends almost from the first. But in irrigation the returns are delayed for years, and interest, maintenance, and selling charges are magnified. Under these conditions it has been found to be impossible to interest capital and to insure it a reasonable profit, unless the selling price of the land is fixed at a figure at least double the estimated cost of construction.

If the percentage of profit is increased, to encourage capital to invest, the increased cost of land works a hardship on the settler, retards development and tends to defeat the very object which it was desired to attain with the increase. Often as a result of the attempt to keep down the cost of land and still allow profits, the construction has not been carried out in accordance with sound engineering practices, with resulting poor service to the irrigator, hard feeling, disputes, losses and annoyances.

Conditions in the valleys of Oregon were, in a way a little too favorable to lend themselves readily to irrigation development on a large scale. The land was sufficiently productive to support a small population under dry farming methods, or with flood water irrigation in the spring, and it had been for the most part taken up before the Reclamation Service and the large irrigation companies entered the field, and the settlers being able to make a precarious livelihood under existing conditions, were loth to place a lien on their lands to assure a permanent water supply. In the other Western States, there were at the same time vast tracts of arid sage brush land, almost entirely in public ownership which were admirably adapted to the workings of the Reclamation Act and on which successful projects have since been worked out.

The State of Oregon is interested in the development of its irrigable lands as a means of increasing its population, its taxable wealth, and the general well being of its citizens. Governments have often undertaken land reclamation projects without any thought whatever of direct return. Thus the British colonial government in India has undertaken the building of many protective irrigation works, as they are called, which in years of drought will save the crops from failure and the people from want and starvation.

In Canada the Canadian Pacific Railway is undertaking the reclamation of three million acres of land with no idea of profit, except indirectly through the increase of freight and passenger traffic.

In Australia, not only the private promoter but also the land speculator has been compelled to step aside for the good of the State. Before public funds are invested in an irrigation enterprise, the dry farm lands are purchased at dry farm prices and after being irrigated by the State, are sold to actual settlers at practically cost of land and water.

It would seem then, that since private agencies have fallen short of the full measure of success in prosecuting irrigation development, the State might well actively undertake the work. As in all engineering work, thorough investigation should precede actual construction. The first step to be taken should be those usually taken by the promoter, the making of preliminary and final surveys, studies of water supply, plans and estimates of cost. The public, should in effect, become its own promoter, acting through some suitable public official, protecting itself during the period of preliminary work by withdrawing the necessary water from the operation of its water laws.

At least two alternatives present themselves for handling the actual construction. The State might assign its water rights and sell its plans and estimates to such persons or corporations as will carry out the projects at a minimum cost to the water users and in accordance with plans and regulations approved by the State. Such contracting parties would reimburse the State for the cost of the preliminary studies. This procedure might well be followed in the case of small projects without complicating features.

With the larger and more costly projects, the State may find it advantageous to carry out its own plans. Being able to borrow money at a lower rate of interest than a corporation, and working with no idea of direct profit it would be able to furnish water to the farmer cheaper than could a private company. The work would be prosecuted solely with the idea of rendering the best service, and building in the most substantial manner, and the final results would be more satisfactory than any company would be likely to achieve.

It was suggested that should the latter plan be undertaken, the State co-operate with the United States Reclamation Service in carrying on this work. The first steps in this direction have already been taken. The last legislature appropriated $50,000 for the investigation of the water resources of the State with special reference to the possible irrigation and power projects on Deschutes River and its tributaries. These studies are now being carried on by the U. S. Reclamation Service which has allotted an equal amount of its funds for the work.

The Deschutes project presents irrigation and power possibilities of unusual magnitude. Just to what extent these possibilities will materialize will depend largely upon the results of the investigations now under way. Deschutes River at Benham Falls above all diversions has a mean yearly runoff of about one and one-quarter million acre-feet. There are available at least 5 reservoir sites for conserving this water and holding the winter flow over until the irrigating season. The largest of these sites located on the main river at Benham Falls has a capacity of 700,000 acre-feet with a depth of water at the damsite of 66 feet and appears to be one of the most favorable sites on the Pacific Coast. The water supply from Deschutes River at this point is sufficient, it has been estimated, to irrigate 390,000 acres. From Tumalo Creek 30,000 or 35,000 acres can be covered. The Tumalo project has already been taken up by the state and construction work toward its completion will be started this summer. On Crooked River there are at present very large areas under water and this area can be very materially increased by storage. With the flow of all the head waters of the river stored

and used for irrigation there would still be a sufficient discharge through the lower canyons from springs and tributaries to generate practically half a million horse power. The Deschutes project as a whole, is altogether too large to lend itself to private development. It is also one which will require careful planning in order that the highest use of the water may be attained. The construction of one or two power plants in the middle portion of the river might involve the creation of water titles which would delay for years the full development of the irrigation possibilities from the stream above and perhaps prevent such full development altogether.

There are other portions of Central Oregon which present conditions fully as favorable as the Deschutes basin for the direct State control of waters. Take for instance the portion of the State from which the streams have no outlet to the sea and which is therefore included in the great interior basin.

In this sparsely settled country the power market and agencies of distribution are yet almost wholly undeveloped, but with the coming of railroads and the development of agrictultural lands a large population will eventually settle there. Electric power will be necessary for municipal use, for traction, and to a very large degree for irrigation. Conditions in many of the valleys in Central Oregon are such as to readily adapt themselves to irrigation by pumping. Most of the streams rise in high mountains surrounding the valleys, and fall rapidly to the border of the hills, then meander with almost no fall through the valley to the lakes in which their waters are lost by evaporation. Canals to conduct the water direct from the streams to the land would involve heavy construction work in the hills while in some of the valleys the gradients are not sufficient for a proper distribution of the water. With electric power available the water can be raised from the streams near the point where it is to be used and distributed in relatively short and cheap canals. It is probable that pumping will play an important part in nearly every project in the interior basin area of southern Oregon, and also in the drainage basin of Klamath River. In this whole area water is relatively scarce. The streams are small and have a very irregular flow and there are only a few localities in which the fall is sufficiently concentrated to make power development cheap and easy. It is especially necessary that the power resources should be conserved and developed to their fullest capacity and applied to the highest use. The maximum utility can be achieved only by a systematic development of these resources by a unified organization.

The pumping of water for irrigation has thus far been carried out only in a limited degree. Rates for power have generally been high, necessarily so because the pumping plants have usually been in small units, distant from one another, the demand for energy has been intermittent and extends over only about half the year at most.

In some places under favorable conditions the sale of electric energy for pumping, may be put on an entirely new commercial basis. Either the power must be furnished continuously throughout the greater portion of the year and the water stored in reservoirs when it is not needed, or the plant must be adapted to using the surplus energy of the power plant at off peak periods when a part of the installed machinery would otherwise be idle. The heights to which water can be pumped under the conditions which have generally prevailed is limited to 100 or 150 ft. With the plant pumping continuously throughout the year using energy at the very low rate at which this would warrant, and storing the water from winter to summer, if feasible reservoir sites exist, it is probable that the lifts could be doubled without increasing the cost beyond what the present value of irrigated land would warrant. Take for instance the lands along lower Snake and Columbia Rivers within two or three hundred feet above the water level. These lands all have a mild climate; are convenient to both railroad and water transportation, and in general have excellent soil. If these were all placed under cultivation the wealth of both Oregon and Washington would be increased to a very large degree and thousands would be added to the population of the two States. The development of these lands may come gradually under private power developments. They should certainly proceed much faster with the lower cost of power that would prevail with development by the public.

The power and irrigation projects which are being developed are becoming more and more of an interstate character. Thus the Northwestern Electric Company is developing power in Washington for sale in Oregon. The Washington Water Power Company of Spokane sells power from its Washington plants to the mines of Northern Idaho. The transmission lines of the Pacific Power & Light Company cross from Washington to Oregon and power generated in either state can be used in the other. The interstate sale of power is a phase of interstate commerce and this becomes a matter of interest to the Federal Government. Some irrigation projects are wholly interstate; others involve the storage of water in one State for use on lands in another, as is the case on Jordan Creek and Sucker Creek on the boundary line between Oregon and Idaho. No one State working alone could adequately manage these interstate projects. It would require co-operation between the two States involved and the Federal Government.

Co-operation between state and national agencies is by no means a new or untried departure. The geological and engineering departments of this and other states have been co-operating for years with the United States Geological Survey. Last year the State of Oregon and the Geological Survey each contributed $28,000 for investigations of river discharge and water powers, and the making of topographic maps, and this year it is proposed to spend an equal amount. Many states have co-operated with the United States Department of Agriculture in irrigation studies, soil surveys and other allied investigations. Local agencies like the Port of Portland have been working along with corps of engineers of the War Department in the improvement of river and harbor for navigation.

The relative advantages claimed for federal and state control of water power and irrigation development may be briefly outlined. The engineering and allied bureaus of the Federal Government have had a

permanent organization which has been maintained over a long period of time. The U. S. Engineer Corps has been charged with the improvement of rivers and harbors for about a century. Other bureaus have been organized for a shorter time but all have been operating sufficiently long to have methods of work well perfected. The government departments are under civil service regulations which insures the permanency of personnel and efficiency of organization. But the government bureaus are criticized and often justly for an excessive amount of red tape and bureaucratic methods and the failure to adapt themselves to local conditions. The state organizations are nearer to the people both physically and in their point of view. They are more responsive to public demands, and are more easily adapted to special requirements. The state bureaus have more often been under the baneful influence of partisan politics and have often been subjected to the disadvantage of frequent changes in personnel. The question as to which agency, state or national, should have the direct handling of any public development of power or irrigation, is not one of theory but of actual practical efficiency.

The results of the exploitation of natural resources by private corporations, in the past, have not been wholly beneficial to the public. The situation at present is in a transitional stage. We may be on the verge of a period of rapidly accelerated development in the material well being of the country as a whole.

Within the last few years the public mind has become awakened to a new realization of its duties to itself and posterity in guarding and using wisely its birthright contained in the natural resources of the country. It is holding the corporations which it has created to serve it to a higher standard of efficiency and to a more strict accountability for their stewardship. National, state and city governments are alike becoming more effective and more responsive to the demand of the times. The people must study carefully and select wisely the policies which are to govern its management of its public utilities.

ELECTRICAL APPLIANCES AT HONGKONG.

Increased and increasing calls for electric appliances, especially for lighting apparatus, fans, and various special lamps, are reported by Hongkong importers. General progress is responsible for much of the demand, but the fact that Chinese merchants have found well-placed electric lights more effective and more economical than the light heretofore used in their places of business is also responsible for the present increase.

The demand for current has been such as to tax the capacity of local plants, while the extensive use of electric light has so directly affected the gas company that a little over two years ago it reduced the price of gas from $3.25 to $2.75 local currency per thousand feet (from $1.46 gold to $1.32 gold at exchange current at that date), and a reduction to $2.60 local currency has been made in the past six months. Further reductions are promised upon the completion of a new installation now being erected.

There is also a strong demand for electric light installations ranging from 60 lights up to 30,000 lights, including complete engine and power equipment, dynamos, switchboards, and wires and cables. The power desired is almost exclusively kerosene, crude oil, or suction gas motors of few and simple parts, which can be run by native engineers. A contract has just been let for a considerable plant at Fatshan, a suburb of Canton, which has been secured by an English branch of a concern generally considered American. A small plant for Kongmun is being competed for. The demand for these small plants is growing to such an extent that various American and other foreign concerns are reorganizing their South China agencies with a view to handling more business.

The demand for electric equipment generally includes all kinds of lamps, lamp stands and shades, particularly the new varieties of metal filament lamps; various grades of insulated wires and cables; insulating blocks; and nearly all modern electric novelties.

The demand for electric fans of all kinds is greatly on the increase. The demands for fans in Hongkong is largely for ceiling fans of wide radius and several speeds. The Hongkong power service is an alternating, 100-volt, current of 72 cycles per second. However, there has developed a considerable demand for desk fans for use aboard ship, and as a rule direct current is supplied for these. The current in Kowloon and various other points about Hongkong is direct.

THE CONCESSIONS SECTION OF THE PANAMA-PACIFIC EXPOSITION.

The concessions district at the Panama-Pacific International Exposition, corresponding to the wonderful "Midway" in Chicago, will be one of the most marvelous and attractive sections of the exposition. Many of the amusements will be presented for the first time and will be notable not only for their great size and artistic excellence but also because they are selected with a view to their educational value.

The number of applications for concessions is said to be totally unprecedented in the history of expositions. So far more than 6000 applications for concessions have been received and seventy-five applications, involving an expenditure of $6,800,000 have been accepted. More than 7000 people, it is estimated, will be employed in the concessions district and between $10,000,000 and $12,000,000 will be spent in installation in the concessions division when the exposition is under way.

The whole concessions district will be three thousand feet in length and will run through the center of the concessions district, sixty-five acres in area. Half way along the length of the thoroughfare will lie the superb "Plaza of Wonders," an area 250 x 300 ft. Surrounding the plaza will be buildings of impressive Roman architecture, in which will be housed many amusement novelties. Here also will be located a great band stand, the sub-offices of the Division of Concessions, and a fire station where methods of preserving life will be illustrated. In the decorative scheme around the plaza will be 140,000 lights, rendering it the glory spot of the night life of the Exposition. In the center of the plaza will be the highest flag pole in the world, a giant flag staff donated by the City of Astoria, 246 ft. high and over 5 ft. in diameter at its base.

ELECTRICAL PUMPING AND IRRIGATION

ROAD CROSSINGS AND DISTRIBUTING CANALS.

BY B. A. ETCHEVERRY.

Road crossings are necessary at all intersections of the canals with the highways and railways. As there are always many of these on every canal these structures are frequently more numerous than any other type. The crossing is usually made by passing the road over the canal by means of a bridge or culvert. For large canals a bridge is frequently used; for smaller canals a culvert is often more economical.

Bridges are usually short and may be made of wood, steel or concrete. The bridge may be made in a single span or intermediate piers may be placed in the canal. The bridge abutments must be connected to the canal with upstream and downstream wings extending well into the banks. When the canal cross section is contracted the bed of the canal must be protected with riprap to prevent erosion caused by the increased velocity. For short spans the bridge may be made of a single floor slab or a floor slab supported on girders. For larger spans regular trusses or arches are used.

Culverts.

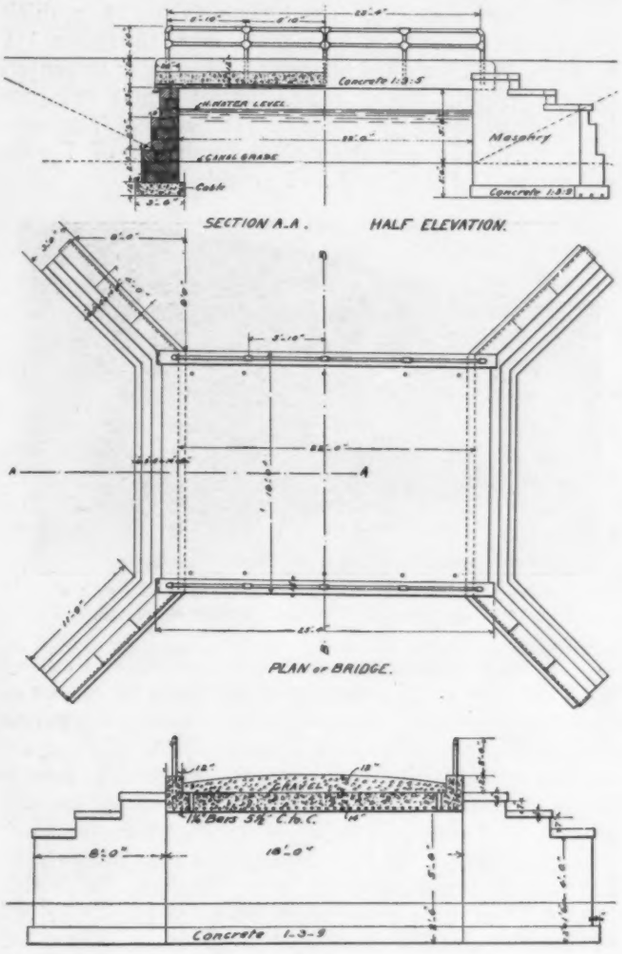
Culverts are of two types, depending on the relative elevation of the drainage channel bed and the canal bed. The first type is used when the drainage channel is sufficiently lower than the roadway to permit the construction of the culvert conduit without depressing the floor of the conduit much lower, if any, than the bed of the drainage channel. The culvert consists of the conduit, the upstream and downstream wing extending well into the banks, the floor between the wings, which is made of concrete, wood or riprap and connects the floor of the canal to the floor of the culvert. The second type is used when the drainage channel is nearly at the same elevation as the roadway and it is necessary to lower the floor of the conduit below the bed of the channel sufficiently to construct the conduit under the roadway. The culvert is then a short inverted siphon and consists of the inlet and outlet well with the connecting conduit. The conduit may be either one or more lines of pipe, a concrete arch or a rectangular box culvert in one or more compartments.

The pipe culvert must be designed to resist external pressure. If the earth pressure is assumed as acting vertically it tends to collapse the pipe by shortening the vertical diameter and lengthening the horizontal diameter. This effect produces equal amounts at the top, bottom and sides (positive at top and bottom and negative at the sides).

Let d = diameter of pipe in ft.
h = depth of fill in ft.
w = weight of fill per cu. ft.

The bending moment equation generally used is $M = 1/16\ whd^2$.

The rectangular box conduit may consist of one or more compartments, depending on the volume of water and on the height available between the floor of the drainage channel and the floor of the irrigation canal. The top or roof of the culvert is designed as a slab for a vertical pressure equal to the weight of earth filling above it. The floor has the same bending moment as the roof. The sides are designed for a horizontal pressure equal to 1/3 the vertical load.



BILL OF MATERIAL		
Concrete	32 cu yds	
Masonry	60 perches	
Coping	36 sq ft.	
Corrugated Bars	3/4-1/2 sq"	
Cable	670 feet	
Pipe	136	2' dia
Tees	10	2" -
Crosses	6	2" -
Elbows	4	2" -

Reinforced Concrete Bridge Across Lamar Canal —American Beet Sugar Co., Colorado.

The cross sectional area is obtained by the short tube formula $Q = CA\sqrt{2gh}$ where h is the height of the water surface at the inlet above the water surface at outlet, C the coefficient of discharge for right corner depends on the length of conduit.

For conduit.	5 x diam.	10 x diam.	25 x diam.	50 x diam.
C =	0.79	0.77	0.71	0.64

With wings flush with the sides of the conduit and placed on an angle of 30 degrees the coefficient may be taken as about .90.

Examples of road crossings are given below. The United States Reclamation Service has issued standard designs with tables of pipe culverts and box culverts.

The county road bridge, American Beet Sugar Company, Colorado, crosses the Lamar canal. It has a span of 22 ft. and a width of 18 ft. The abutments and wings are of masonry. The bridge slab is 14 in. thick and made of concrete reinforced with thirty-six 1¼ in. bars, 24 ft. long and spaced 5½ in. center to center. On each side a coping which carries a pipe rail projects 12 in. above the floor of the bridge. The concrete used was mixed in the proportion of 1 part cement to 3 of sand and 5 of gravel.

Culvert Railroad Crossing With Warped Wings for Inlet and Outlet, Umatilla Project—Oregon.

Many of the crossings of the Santa Fe Railway with the laterals of the district are made by means of inverted siphons. These siphons consist of concrete inlet and outlet chambers spaced about 18 ft. apart and connected with cast iron pipes. The size and number of pipes vary with the size of the lateral, usually from 1 to 5 pipes, 24 to 36 in. in diameter are used. The pipes are placed horizontally and the outlet chamber is 6 in. lower than the inlet chamber. With this head a 24 in. pipe gives about 80 second ft. The bill of material given is for five 24 in. pipes.

In southern California cement pipe is extensively used for road crossings especially for the small ditches. The crossings usually consists of inlet and outlet chambers each made of one or two joints of large size cement pipe placed on end vertically, and connected at the bottom through a smaller size cement pipe laid across the road. The water is carried to the inlet through a cement flume which is connected to the top of the inlet pipe. To prevent the entrance of large bodies a screen is placed at the entrance. As the ordinary cement pipe will not stand great weight, if the road is used for heavy traffic the pipe should be very carefully backfilled. The strength of the pipe will be very much increased by forming a concrete bed around the lower half of the pipe. For large size pipes reinforced concrete is much more desirable.

Distribution System.

The distribution system consists of main laterals, sub-main laterals and individual distributaries or laterals whose purpose is to deliver the water at each farm. The main canal commands all the land to be irrigated which extends generally from the main canal down to the main drainage channel. This area seldom has a uniform slope but is divided into basins separated by ridges. For each basin there is usually a drainage line. The main canal, which is located along the higher boundary of the irrigated land, intersects these ridges. The intersections with the ridges are the heads of the main laterals. The main laterals are located as nearly as possible on the line of these ridges and each one commands the land on both sides extending from the watershed or ridge line down to the drainage line of each basin. Every main lateral is the source of supply for sub-main laterals commanding subdivisions of the area commanded by the main lateral. The sub-main laterals are the source of supply for the smaller laterals or distributaries whose object is to carry the water to each farm. Usually no water is taken out directly from the main canal or main laterals by the farm ditches or distributaries. It is always desirable to use as many main laterals as possible and to decrease to a minimum the total length of small distributaries because of the greater percentage conveyance loss in small canals.

In the lowest part of the basins and sub-basins forming the total area irrigated, are the drainage lines. These drainage lines may be well indicated by natural channels or creeks or may be the lowest thread of very gradual and flat depressions. These drainage lines are usually the place where the excess water collects and if not obstructed is carried to the main drainage channel or stream. On all systems except some pipe systems the main canal and distributaries cannot be operated with sufficient accuracy to prevent surplus or unused water at their lower end. If these lower ends are on private property the discharge of the surplus water at these points would cause not only local damage but may cause general waterlogging of the land below. For these reasons all canals should be terminated at a drainage or waste channel. Where the land is not provided with natural drainage channels it is usually necessary, except where water is used very economically and with great care, to provide artificial channels or improve existing channels. When the drainage channels are not sufficient to prevent the rise of alkali and the waterlogging caused by excessive irrigation, it is necessary to construct a complete drainage system. To remove alkali usually requires a system of underdrains for the lands so affected. Many irrigation systems should have a complete drainage system. It has been estimated by the Bureau of Soils that 13 per cent of all irrigated land had been rendered worthless or damaged because of the rise of alkali.

The main laterals and sub-main laterals usually follow the ridges as stated above and should be continued so that they will end at some drainage channel. The small laterals or distributaries will, if possible, be made to conform with the property lines and road lines. Because of the steep slopes sometimes obtained on the ridge it is necessary to use many drops.

The principals of design of the canal cross sections are the same as those given for the cross sections of main canals. The water level of the smaller

distributaries must be kept sufficiently above the surface of the ground to permit the installation of measuring boxes and the irrigation of adjacent land. This is very necessary in a flat country. The main canals and main laterals must be so designed and located that the water level will be kept sufficienty high to permit the diversion into the branches without the use of checkgates to hold back the water and raise the water surface. It is desirable to carry the water surface in the distributary even when partly full, at sufficient elevation above the highest point of land to allow for the loss in velocity head through the take out box and for the installation of a measuring box. Ordinarily a minimum of 6 in. and preferably 12 in. difference in elevation between the water surface in the supply lateral when running at ½ full capacity and the highest point of land to be irrigated must be provided. The checking of the water is not desirable because it increases seepage loss, encourages deposits of silt and may cause the overflowing of the banks and resulting breaks. However, they are frequently unavoidable. The grades and cross section must be adjusted to obtain, if possible, a gradually increasing velocity.

Continuous and Rotation Flow.

In a large system the main canal, main laterals and often the sub-main laterals are operated continuously, each receiving its proportionate share of water. The smaller laterals or distributaries may also be operated continuously but it is usually preferable to operate them intermittently according to a system or schedule of rotation which allows instead of a small continuous flow during the entire irrigation season, a greater volume for only part of the time or periods occurring at regular intervals. The advantages of the rotation system are:

1. The proportionate loss of water is less than by the continuous method because of the smaller percentage conveyance loss obtained with large volumes as compared to smaller volumes.

2. The larger head is very desirable and in some cases absolutely necessary to give to the irrigator a flow which can be handled. For instance a duty of 1 miners' inch to 5 acres may be ample, but if the orchard is only 10 acres and rotation is not practiced, then the orchard is entitled to a continuous flow of 2 miners' inches. With a stream of this size it would be hardly feasible to irrigate it. But if the irrigator is allowed 40 miners' inches for 1/20 of the time or 1½ days each month, he will receive the same amount of water and will be able to apply it in a very short time.

The disadvantages of the rotation system are.

1. It requires larger canals.

2. When the rotation periods are too frequent the loss due to the canal being alternately wet and dry may be greater than the saving due to the smaller percentage loss in conveyance.

3. The system of rotation requires the distribution according to a rotation schedule which increases the labor of operation.

The system of rotation is generally applied only to the smaller distributaries or to groups of distributaries, but may be applied to the sub-main laterals or even main laterals, on large systems during periods of low flow. The operation then becomes very complicated. A simple illustration is the following. If a main lateral supplies two sub-mains each irrigating about the same area, the entire flow may be allowed in each sub-main lateral in turn for one-half the time. Then the flow in each lateral may be subdivided in turn into groups of smaller distributaries.

Carrying Capacity.

In planning the carrying capacity of the canals of an irrigation system the duty must be known. The duty will usually vary considerably during the irrigation season. The demands are greater in the summer months than at the beginning or at the close of the irrigation season. When the stream flow is sufficient to meet this maximum demand the system should be designed for this maximum demand. On the other hand when the stream flow is insufficient to supply the water at this time of maximum demand, but is ample at the beginning of the season, then it will be desirable to use the largest volume at the beginning of the season and plan the system for this duty. The carrying capacity of the main canal and main laterals are based on a continuous but not uniform flow depending on the duty of water determined for the period of maximum demand or maximum available supply and on the area irrigated, making all necessary allowances for conveyance losses and for the acreage of the land under the system which will not be irrigated, such as land occupied by roadways and buildings and land which is dry farmed or not farmed at all. The relative amount of water used during the irrigation season for different sections of the arid region is illustrated by the following examples:

Relative Amount of Water Used During Irrigation Season Expressed in Per Cent of Entire Amount.

	Riverside Water Co., California, 1901-1908.	Rocky Mountain States: Colo., Wyo., Utah, Idaho.	Snu River Project, Montana.	Lower Yellowstone Project, 1909.	Yellowstone Montana, 1910.	Sunnyside Canal, Washington, 1909.
Jan. ..	5.3					
Feb...	2.0					
Mar....	3.4					
April..	7.8		1	2		8.5*
May ..	12.8	10	9	2	8	20.
June .	12.0	30	30	21	22	20.
July .	12.0	30	22	31	32	21.
Aug. ..	11.8	20	30	22	13	22.
Sept ..	10.6	10	8	18	22	9.5**
	8.3			6	3	
	7.0					
	7.0					

*April 15-April 30. **Sept. 1-Sept. 15.

The carrying capacity of the main canal should be decreased at the intersections with the main laterals according to the amounts taken out. This will also apply to the main laterals if rotation is not practiced between sub-main laterals. The carrying capacity of the sub-main laterals, when rotation is not practiced between them, is based also on continuous flow, but in case of rotation the carrying capacity will be based on the duty and the frequency of the periods. When the smaller laterals or distributaries supply only one or a few farms, it must have a carrying capacity of at least one irrigating head, and the time for which this head is supplied in turn to each farm depends on the size of the head as compared to the continuous flow allowance. When the distributary supplies a number of farms the carrying capacity may be figured on a continuous flow and the volume divided into a number of irrigating heads supplied in rotation to groups of farms.

PROBLEMS IN THE REGULATION OF PUBLIC SERVICE UTILITIES.

BY G. A. LEE.

For some time, in Washington and other states, common carriers, including primarily steam and electric railroads and telephone and telegraph companies, have been subjected to rigid state and federal regulation and supervision. Only in recent years, and only within the last two years in Washington, has the police power of the state been extended to include and regulate other public service utilities, such as water, gas, electric light, power, and irrigation companies. We have today in this state a comprehensive and scientifically drawn public service commission law.

Public service commissions, if composed of fearless, intelligent, reasonable, and fairminded men, are a great benefit, in my judgment, not only to the various communities, but also to the various utilities regulated. The commissions act in many instances as arbitrators between the public on the one hand and the utilities on the other, and by intelligent, sane and conservative action and treatment, settle innumerable disputes, some of a petty, and some of a grave nature, thus avoiding friction and litigation, and establishing and directly creating a better relationship between the public service company involved and its patrons.

Another benefit flowing from regulation of this character is the fact that frequently a patron or consumer of the company is unwilling to believe that there is a company's side to the controversy. By intervention and investigation the public service commission frequently finds that the attitude of the company is correct and should be sustained, advising the complainant accordingly. The complainant, having had the opportunity of appeal to an impartial and unbiased state tribunal, is satisfied, the dispute is closed, the controversy ended, and a better feeling established. This is very frequently done by commissions in what would seem to be small and minor matters, but as you all know, the disposition of these minor questions means the establishment of the good will of the patrons or consumers, and such good will is a valuable asset. Many concrete instances might be cited, in which the Washington commission for instance, has acted promptly and efficiently, as above suggested, with gratifying results, but I think that the mere statement of the general proposition speaks for itself.

Again, and perhaps the most important benefit arising from state regulation is the fact that public service utilities are gradually but certainly being removed from the sphere of local politics. Heretofore, public service companies have frequently been compelled to be the "football," so to speak, of municipal politics. It must be apparent, and is apparent to all fair-minded students of the problem, that so long as local prejudice, jealousies, and influences control in the local regulation of public service utilities, such regulation can never become effective or wholesome.

A third, and fundamentally important benefit arising from commission laws is the fact that public service regulation is the only reasonable alternative of public control and ownership. Such regulation affords and secures all of the benefits and advantages incident thereto. If such regulatory laws secure to the people good service, reasonable rates, and safe and efficient instrumentalities and facilities, then certainly there can be no logical or convincing argument in behalf of the surrender of such regulations for the experimental and dangerous plan and principle of municipal or state ownership.

In my judgment, the passage of public service commission laws in many states in the last few years marks a new regime, and gives to the public that service and those rates to which they are entitled, and gives to the companies that protection and that rate of return which the constitution and fundamental laws of the land permit, and at the same time avoids the dangers and pitfalls of municipal regulation and municipal ownership.

Hastening, and coming now to a brief discussion of the dangers of public service regulation, we come to a field that is extremely important. It may be admitted, and in view of the foregoing facts and data, will be admitted that efficient, capable, and honorable public service commissioners can and do render invaluable service to the state and to the companies. If, on the other hand, the members of the state commission lack courage and integrity, and attempt to prostitute their position and immense power for ulterior personal or political ambitions, then and in that event the entire superstructure of regulation falls and such regulation becomes a mere fiasco.

Politics have no place in public service commissions. The members of these commissions should be men of fine ability and integrity; of fearless and judicial temperament; otherwise the failure of the work will be just as great as municipal control has been in the past, and the fundamental vice of municipal control rests, of course, in the politics of the situation.

Another danger of public service regulation is the fact that many commissions are not able, or are unwilling, to take a broad, fair, and reasonable view of the problems confronting them. If, for instance, values of public service properties are placed low in order to satisfy popular clamor; if the law and the facts of the case are ignored; if unfair, unreasonable, and confiscatory rates are imposed and ordered, and if generally speaking the utilities are not accorded those rights, privileges, and protection to which the law and the constitution entitle them, then the dangers and pernicious results of such regulation outweigh all of the advantages and benefits outlined above.

Recently, in Washington, D. C., in conversation with the chairman of a certain public service commission of one of the Mississippi Valley states, he stated to me that in no event should capital invested in public service properties be entitled to a greater net return than two per cent. The only argument which he presented in favor of such a statement was that capital, both active and inactive, in the United States averaged no greater rate. This commissioner either overlooked or ignored the speculations, hazards, and dangers incident to many investments in public service properties. He apparently forgot that capital is frequently sunk in these enterprises for many years before any returns are received. He forgot that many of these great industries are constructed years in ad-

[The following article is abstracted from an address before the Stone & Webster Club at Seattle, Wash.—Ed.]

vance of the time and that large cities are frequently made possible by the foresight, judgment and wisdom of investors in public service properties. In all other industries these facts and factors are rewarded; why not in the public service business? I answered him by saying that the courts, both state and federal and the most eminent commissions of the United States had almost universally held that any net return under six per cent was unreasonable, confiscatory, and unconstitutional. His only reply was that the courts and commissions were wrong. I cite this conversation to show what I mean by one of the very grave dangers of public service regulation.

In touching upon the last and final thought, as to how regulation can be made more effective, I simply wish to challenge your attention to the fact that you are not only employes of your particular companies, but are citizens of the state. As such citizens and as such employes you are charged with the important duty of obeying the statutes and laws of the state. If you conscientiously perform that duty, and discharge the obligations and duties imposed upon you by the public service commission law there is no question but what regulation can be made more effective. Good service on the part of public service companies can only come from efficiency, loyalty, industry, and integrity on the part of its employes. A public service company can be no stronger than the character of the men who constitute it. Such qualities and practices not only spell good service, but in the final analysis mean that fewer complaints are registered against the company, either with the company or with the commission. The people generally require and are entitled to good service; whether or not that service will be furnished rests in your power.

The question of rates is generally a secondary and inferior one, and it is therefore essential that each employe should direct his best energy and ability toward good service. If so the relationship between the company and the public will be a pleasant one and the relationship between the company and the public service commission agreeable and harmonious. The attitude of the average employe with whom the public comes in contact frequently determines the judgment and attitude of the public toward the company which the employe represents. This is fundamental and needs only to be stated to emphasize its importance.

A somewhat extended experience on the public service commission of Washington convinced me that the utilities of the State are meeting the regulatory legislation of the state in a fair and honest manner. They fully realize that their business is impressed with a public use and that the consuming public is entitled to certain legal rights. On the other hand, experience has shown that the average citizen is reasonable, and that if relief is denied by the commission the complainant is generally satisfied. The greatest enemy of public service regulation today is the unfair and unscrupulous municipal agitator, desiring political or other preferment, and appealing to the sympathies and prejudices of the people. The people cannot always be misled, however, and are rapidly coming to recognize and appreciate that there are two sides to the controversy, and that equity and fair treatment must be accorded the utility if the community is to progress and prosper.

As the supreme court of the United States in the case of Knoxville vs. Knoxville Water Company, 212 U. S. 18, remarks:

"The regulation of public service corporations, which perform their duties under conditions of necessary monopoly, will occur with greater and greater frequency as time goes on. It is a delicate and dangerous function, and ought to be exercised with a keen sense of justice on the part of the regulating body, met by a frank disclosure on the part of the company to be regulated. The courts ought not to bear the whole burden of the saving of property from confiscation, though they will not be found wanting where the proof is clear. The legislative and subordinate bodies, to whom the legislative power has been delegated, ought to do their part. Our social system rests largely upon the sanctity of private property and that state or community which seeks to invade it will soon discover the error in the disaster which follows. The slight gain to the consumer which he would obtain from a reduction in the rates charged by public service corporations, is as nothing compared with his share in the ruin which would be brought about by denying to private property its just reward, thus unsettling values and destroying confidence. On the other hand, the companies to be regulated will find it to their lasting interest to furnish freely the information upon which a just regulation can be based."

The regulation of public service corporations is a delicate and dangerous function, and ought to be exercised with fairness and justice. I have an abiding faith in the sound judgment of our Western people. Their spirit of fairness is always dominant. The great issues above suggested can never be settled until they are settled right. On the one hand let us demand of the public service companies that they serve the public fairly—efficiently; that their rates be reasonable, consistent with their investment and hazards; that they faithfully discharge their trust as public agents and almoners of public necessities. On the other hand, let us insist that fair and honorable treatment be accorded these utilities. Let us do all we can to remove them from the sphere of petty politics and local jealousies. Let us educate our people to the fact, so well expressed by the Supreme Court of the United States, that our social system rests largely upon the sanctity of private property and that utilities, as well as all others, are entitled to a fair compensation for their service, their risks, their investments.

Let us meet and solve these fundamental problems in a calm, judicial, and dispassionate manner. Let us all, regardless of political creed or business connection, regardless of personal or sentimental considerations, earnestly seek the law and the facts. And finally, let us remember in our efforts to adjust and settle these grave economic, financial, industrial and social questions that equity and fair play should be accorded equally and without discrimination to all public service corporations, as well as to all citizens.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

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On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	" "	3.50
Other Foreign Countries within the Postal Union	" "	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advrtisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Transformer Oils

Transformer oil, its proper character, treatment and use, has been much neglected by central station engineers. It forms one of the weak links in the chain of a high-tension electric-transmission system. In its dual function as insulator and cooler it requires high dielectric strength and high flash point, combined with great fluidity. It should be neutral so as to not dissolve the insulation of the core and coils immersed in it.

Of these qualities, the dielectric strength is the most variable, for it depends largely upon the amount of moisture present. The popular axiom that oil and water do not mix is not scientifically correct, for oil does absorb a small amount of moisture that materially lessens its dielectric strength. We know of an oil that broke down under 16,000 volts when wet, but stood the test of 40,000 volts after being dried. While oil and water do not chemically mix, they may mingle so closely as to require steam or rheostat heating to remove the water. Every precaution should be taken to keep oil dry during shipment and in use, for it abhors dehydration even more than "Nature abhors a vacuum."

It should have a high fire or flash test to eliminate danger of fire. Crude oil is refined by fractional distillation, the most volatile products passing off first. These are low in gravity and in burning temperature, as is exemplified by gasoline. Kerosene for use in lamps is one of the next products, soon followed by an oil suitable for transformer purposes. This usually has a gravity of 30 degrees, Baume, or less, and burns at about 300 degrees, Fahrenheit. The higher the temperature at which the product is distilled, the greater its viscosity. Consequently what is gained in flashing temperature is lost in fluidity. Acid introduced into the refining must be removed by adding just enough alkali to render the oil neutral. Many other valuable products of oil refining have been and are yet to be found, but "they are another story."

These conditions, briefly outlined, have been met by various companies supplying transformer oils. On the Pacific Coast, Eastern "Mineral Seal" was first used. Later, Western "Mineral Seal" was introduced, it having an asphaltum instead of a paraffine base. Subsequently, "Transil No. 6" and many other oils, whose names are legion, have been offered for sale, much as each druggist sells his own brand of hair restorer. Nearly all these are originally bought from the same company, mayhap the same tank, and have been specially treated to impart the desired qualities. The trade name is a distinction without much difference in quality. Disastrous fires, occurring when the oil has been volatilized by an arc, are credited to one and all of them. Another frequent trouble is the deposition of a thick, carbonaceous, jelly-like sludge on the cooling coils and in the circulating ducts. The former are covered so thick that cooling is not effected, and the latter are so clogged that circulation is difficult. Such deterioration generally occurs when the oil has been overheated. The deposit is easily washed off when hot, but becomes hard and brittle upon exposure to the air, resembling bitumen in this respect. The deposits around the points of high potential allow

creepage, so that a medium of high resistance may become a conductor.

But careful examinations of these troubles show that they are usually due to no inherent fault of the oil, but to the transformer design, or more particularly to the attendant's carelessness. We have instances of transformers that have been in continuous service for twelve years without any change being made in the oil. As a consequence, is it to be wondered that the transformer runs hot? Its design is condemned by the man who has grossly neglected it. He futilely attempts to remove the difficulty by changing to another oil, temporarily solving the question until this oil, too, becomes unfit for service, and the same trouble again occurs. Careful break-down tests should be made not only when the oil is furnished, but at frequent intervals thereafter, once a month not being too often for main stations. Tests for acidity will avoid the destruction of the insulation by dissolving, and flash tests will often prevent fires. The carbon may be removed by occasional filtering. In case of leaky cooling coils, the water should be drawn off from the bottom until such time as the transformer can be taken out of service and properly repaired.

All this trouble occurs with both water and self-cooling transformers. Where water is plentiful, it has been suggested that outside circulation of the oil would cause better cooling, and larger ventilating ducts would not become clogged. We attain success only by the most careful attention to the details of our work. Look after the oil, and transformer troubles will take care of themselves.

The Romance of Engineering

It is a matter of current comment that the life of an engineer is an unromantic one; that the deadly monotony of his work tends to blunt his finer sensibilities. While we must admit that it is not a particularly exhilarating task to hold the speed indicator on an engine or to watch a weir, and that it is not conducive to the development of the imaginative faculty "to determine the maximum number of blisters that can be placed upon the thumb by the ring end of a steel tape," yet the same may be said of almost any other kind of work that fits for higher things. It is only through the apprenticeship of drudgery that the master workman is developed.

The main essential is not to become a mere time-server while learning the necessary rudiments, but rather keep the mind receptive to new ideas, and observe the possibilities for improving old methods. In this age of action and energy there seems to be a tendency to neglect that old-fashioned virtue of occasionally thinking of something beside the humdrum of work. The engineer that allows his work to run him, who goes to his home so preoccupied with his difficulties as to neglect his family ties, is not living, but merely existing.

There is, perhaps, no better way of illustrating our meaning than by referring the reader to some of the writings of Kipling wherein he deals with the romance of the commonplace. He shows us the romance of everyday life, of commerce and of machinery. Refuting the idea that every new invention or discovery tolls the knell of romance, he tells of the pleasures of the locomotive and marine engineer who can lighten his work with an appreciation of the beauty, wonder and love for life, "though there arn't a wave for miles and miles excep' the jiggle from the screw," yet the fascination of seeing the world keeps him satisfied with his work.

The great trouble with most of us is we do not see beyond the end of our monkey-wrench. It is not necessary to become idle dreamers, but a little exercise of our imagination, an occasional study of the ideal, will raise us from the rut of the commonplace and remove that stigma of being unromantic.

Utilization of Atmospheric Nitrogen

The tiller of the soil may be likened to the owner of the magical wild ass' skin in Balzac's story of the "Peau de Chagrin." While the possession of this skin gave the means of satisfying every wish, yet its size represented the duration of the owner's life, and for every desire gratified the skin shrank accordingly, until finally both life and hide vanished with the gratification of the last wish. Similarly nitrogen and other foods required for the growth of plants are withdrawn from the soil by each successive crop, until at last the land becomes exhausted—the electrolyte in the storage batteries which furnish the power used by man is low. It has been found, however, that by adding nitrogenous compounds to the soil its fertility may be restored. But so rapidly—more rapidly than they are being replenished—have the natural manures been depleted by an ever-increasing demand, that all available guano and sodium nitrate deposits will ultimately be exhausted. The sorry plight of the Ancient Mariner, "water, water everywhere, nor any drop to drink," until recently bid fair to be that of the farmer, living in a sea of nitrogen but unable to use it for his most pressing need, that of fertilizing a wasted earth. Neither plants nor animals can exist without nitrogen, and yet they cannot assimilate it from the air they breathe.

It seems strange that elementary nitrogen is so inert, and yet its compounds are so singularly active; inert as a diluent of the air, active in explosives and in the poisonous alkaloids, such as morphine and strychnine. Because of this marked inertness, possibly due to the strength of the atomic bonds within the molecule, and because of the indirect processes by which its compounds are formed, as well as their usual instability, the fixation of atmospheric nitrogen has been a difficult task.

Nitrogen is one of the most abundant, and at the same time one of the most expensive elements. There are nearly twenty million tons of nitrogen in the air over every square mile of the surface of this earth, or over seventy million times as much as is contained in the 1,740,000 tons of saltpetre exported from Chili in 1907. Though it exists in such enormous quantities, heretofore it has been directly used by only a few plants which were able to absorb the nitrogen from the air diffused through the soil. Here it is that the puny strength of the tiny microbe is almost as powerful as the mighty force of electricity, which is now being used to supply thousands of tons of commercial fertilizers.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

D. S. Ewart, electrical contractor of Astoria, Oregon, visited in Seattle last week.

Ralph Krows, proprietor of the Ralph Krows Electric Company, Seattle, is spending a week east of the mountains on business.

E. M. Cutting of the Edison Storage Battery Company, San Francisco, is making an extended trip through Southern California, Arizona and New Mexico.

H. B. Squires of the firm of H. B. Squires & Company, San Francisco, returned home the first part of the week after an extended trip to Chicago and the east.

C. F. Adams, having completed the Kaweah No. 3 power plant in the Sequoia National Park, for the Mt. Whitney Power Company, has returned to San Francisco.

T. W. Peters, formerly with the operating division of the Seattle light department has joined the force of the General Electric Company at Schenectady, New York.

W. L. Goodwin, manager of the Pacific States Electric Company, left the beginning of the week for a couple of weeks' vacation in the woods of northern Marin county.

W. F. Nieman, sales manager of the Great Western Power Company, is again at his desk after a few weeks' auto-vacation trip through Lake and the north of bay counties.

E. S. Code of the detail and supply divisions, Seattle office Westinghouse Electric & Manufacturing Company was recently married to Miss Elizabeth Merilees of Vancouver, B. C.

W. Guthfahr, electrical engineer, formerly of Sonora and Chihuahua, Mexico, is in San Francisco and is supervising the electrical installation at the Avon plant of the Associated Oil Company.

A. E. Barlow, coast sales manager of the American Ever Ready Company, with headquarters at San Francisco, paid a business visit trip to Seattle, Spokane and other northwest points recently.

W. Brewster Hall, representing Pass & Seymour, at San Francisco, who underwent an operation for appendicitis on the 10th of this month, is again at his desk and performing regular office routine.

John C. Bird, formerly with the Kendrick Electric Company, Tacoma, has been made manager of the Westinghouse Lamp Company's Seattle office, succeeding **R. H. DeMott**, who has gone to the Chicago office of the company.

Wm. E. Roos, representing the Western Wood Preserving Company, Los Angeles, has established headquarters at room 501, Rialto Building, and is devoting his time to the care of the company's interests in the northern part of the State.

H. J. Gille, who resigned from the position of general manager of the St. Paul Gas & Electric Company at St. Paul, has arrived in Seattle and accepted the position of sales manager for the Puget Sound Traction, Light & Power Company.

Alexander G. McAdie has accepted the chair of Professor of Meteorology and director of the Blue Hill observatory at Harvard University, and will assume the duties of his new position in the fall. He will succeed the late Professor A. L. Rotch, who founded the observatory and who has done pioneer work in exploring the air.

Professor McAdie was born in New York in 1863. He was graduated from the college of the City of New York in 1881, receiving his A. M. degree from there in 1884 and the same degree from Harvard a year later. His service with the United States began in the Signal Office in 1886. He was for four years connected with the Weather Bureau at Washington and later went to New Orleans as local forecast official. He came to California in 1899 as local forecast official and was for a while connected with the University of California as honorary lecturer. He has held his present position as forecaster in San Francisco for eighteen years and in that time has won a host of friends.

Courtesy of Town Talk Publishing Co. Alexander G. McAdie

During his long career he has written many scientific publications. "Clouds and Fogs of San Francisco," written about two years ago, is his best known book. He is an associate editor of the National Geographical Magazine, a member of Washington Academy of Sciences, and president of the Astronomical Society of the Pacific.

Professor McAdie has written a number of articles for the Journal of Electricity on Water Supply, a subject of greatest importance to the engineer. He was also for a number of years one of the executive officers and a director of this journal.

He will be missed by his many California friends, who wish him success in his new connections.

NEW PRESIDENT OF THE GENERAL ELECTRIC COMPANY.

Mr. C. A. Coffin has resigned as president of the General Electric Company and Mr. E. W. Rice, vice-president of the company, has been elected as his successor. Following his resignation as president of the company, Mr. Coffin was elected chairman of the board of directors. Mr. Coffin has served as president of the company since its organization as the General Electric Company and his successful career in that position is aptly illustrated by the wonderful success of the company.

Mr. Rice has also been connected with the company since its organization and his ability to carry on the work of his predecessor is unquestionable.

OBITUARY.

Fred Neilson, the well-known electrical contractor of the firm of Neilson & Smtih of Santa Barbara, died Monday, June 23r, at his home after a long illness. Mr. Neilson was president of the Santa Barbara Local State Contractors' Association and during his connection with the contracting business made many friends who deeply regret his death. He is survived by a widow and one child.

MEETING NOTICES

Electrical League of Southern California.

At the regular meeting of the League held at the Angelus Hotel on June 24th, Mr. Paul Shoup, president Pacific Electric Railway, gave a talk on "Transportation." This will be the last meeting until September.

Electrical Development and Jovian League.

The final meeting before the vacation period July 1 to Sept. 1, was held last Tuesday. It being an entertainment meeting no special business was transacted. The speaker of the day, Mr. F. H. Brown, talked on electric sign wiring and display.

Los Angeles Jovian League.

At the rejuvenation held on June 19th at the Union League Club, 27 candidates were initiated. There were 62 Jovians present to enjoy the banquet and popular song choruses which were printed on the menu and sung by all. The rejuvenation was necessary due to the great enthusiasm shown at the last one held on May 19th.

Seattle Jovian League.

The Seattle Jovian League has found that it cannot procure the proper facilities for making a display during Potlatch week, and instead of the electrical float or pageant will give a special luncheon and entertainment Friday noon at the Rathskeller. A general invitation will be extended to all electrical men in the city to be present and all of those out of the city will be invited as guests of the Jovians.

Oregon Technical Club.

Mr. D. D. Clark, Chief Engineer for the Portland Water Board, gave a historical sketch of the water supply of the city of Portland, at the regular Monday luncheon of the Oregon Technical Club. Mr. Edwin A. Taylor, Superintendent of Construction, explained the physical properties and method of serving the growing population of the city. He also dwelt at length upon the development of the system, and described the new Mount Tabor reservoirs. Mr. E. A. Stanley was chairman of the day.

San Francisco Section, A. I. E. E.

The results of the May election were as follows: Mr. C. J. Wilson and Mr. A. H. Griswold were elected to the two-year term, and Mr. J. P. Jollyman to the one-year term, Mr. P. T. Hanscom and Mr. A. G. Jones being the holdover members of the executive committee.

It will be the endeavor of the executive committee to arrange a complete programme of papers to be presented during the season and place this programme in the hands of the members during the coming September. The secretary would be pleased to hear from any member who would like to make suggestions as to subjects which would be treated during the 1913-14 season. Such suggestions should reach the secretary before the end of July. The next meeting will be held the fourth Friday in September.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The Mount Jackson Water and Power Company has appled for authority to issue $11,000 in bonds for the purpose of paying off certain indebtedness and of making improvements to its system. The Mount Jackson Water and Power Company operates in Rionido, Sonoma County.

The commission has rendered a decision granting authority to the Southern California Edison Company to pledge as collateral security for loans a portion of the $2,500,000 of bonds previously authorized by the commission.

The commission has granted authority to the Pacific Gas and Electric Company to issue $5,000,000 of its general and refunding mortgage bonds at 85 and $150,000 in promissory notes.

The Home Telephone and Telegraph Company has been granted a certificate of public convenience and necessity to exercise franchise rights in the city of South Pasadena, Los Angeles County.

TRADE NOTES.

The Wahlgren Electric Company, Everett, Wash., has secured the contract for the entire lighting and power installation in the Everett Ice Company manufacturing plant.

The North Coast Electric Company has purchased the business of the Kendrick Electric Company at 710-712 Wistun avenue, Seattle, and will continue business at that address.

A. W. Wilkinson & Sons, sawmill designers of Minneapolis, are preparing plans for the complete electrification of the Weyerhaeuser Timber Company sawmill at Everett, Washington.

The Pacific States Electric Company anounces the completion of sales arrangements with the American Cross Arm Company and will in future handle their product on the Pacific Coast.

The Sound Manufacturing Company, 810½ Railroad avenue, Seattle, has installed a large amount of machinery to be used in making special boxes for electrical appliances on short notice.

The Seattle city council has awarded a contract to Nettleton-Bruce-Eschbach Company, a local concern, for constructing the masonry power and water supply dam on Cedar river at $687,110.

The Ralph Krows Electric Company, Seattle, recently made extensive improvements in its place of business, putting in a new front, new signs, etc. A large amount of shelving and other fixtures will be installed in the near future.

Lewis, Wiley & Morse Inc., hydraulic contractors, Seattle, have a contract to make a 100,000 yard fill for the Northern Pacific Railway Company. This work is being done in connection with a contract under way for the city on Alki avenue.

The Pacific Electric Company of Everett, Washington, recently installed complete electrical equipment in the laundry building of the Cavanaugh Timber Company at Camano, Washington. This company has also completed the job of installing electrical equipment in the Princess Theater at Everett.

The Reynolds Electric Company, 310 First avenue south, Seattle, is putting in a 50 h.p. Westinghouse 2000 volt motor for the Hammond flouring mills. Motors are also being rearranged and the high tension work put in first class shape. The new installation is in addtion to the 600 h.p. already installed.

The Puget Sound Traction, Light & Power Company is supplying power for the operation of the new shingle mill of the Clough-Hartley Company of Everett, Washington, The mill will have a capacity of 500,000 shingles per day and will be electrically operated throughout. The General Electric Company furnished the complete equipment consisting of transformers and motors.

An innovation has been added to loose leaf net price book distributed by the Pacific States Electric Company showing all cuts available for advertising, which are furnished free to the trade. This innovation has proven particularly attractive to dealers and contractors throughout the country who have occasion to advertise electrical material and who have been handicapped in the past with their inability to secure these cuts on short notice.

NEWS NOTES

INCORPORTIONS.

DINUBA, CAL.—Alta District Gas Company, $45,000 by A. A. Weber, G. W. Wyllie, R. W. Wilson and W. L. Muncy.

LOS ANGELES, CAL.—Petroleum Gas Reduction Company; capital stock, $500,000; W. C. Cutler, W. P. Stevens, J. F. Vordermark, G. I. Leonard and R. O. Wrana, directors.

SEATTLE, WASH.—The North Coast Electric Company has been incorporated under the laws of Washington to deal in electrical applicanaces and supplies. The capital stock amounts to $60,000, all of which has been subscribed. Officers of the company are Harry Byrne, president and manager; E. R. Welles, New York, vice-president and treasurer and W. R. C. Cocke of Seattle, secretary.

ILLUMINATION.

KLAMATH FALLS, ORE.—First steps have been taken toward the municipal ownership of light and power for the city.

ALHAMBRA, CAL.—The lighted way within the limits of Alhambra is soon to add another five miles to the system already in operation.

ABERDEEN, WASH.—A petition for a municipal power and light plant has been presented to the council. The estimated cost is $900,000.

FULLERTON, CAL.—Residents of Placentia have petitioned for the formation of a lighting district, in order to provide street lights for this community.

OAKLAND, CAL.—The contract for street lighting for the coming fiscal year has been awarded to the Pacific Gas & Electric Company by the city council.

BUTTE, MONT.— A petition will be presented to the council for the extension of the luminous arc lighting system to practically all of the business district.

MONTESANO, WASH.—J. F. Hartsung and F. Norton Babo have organized a light and water company and will apply for a franchise in this city. They guarantee to furnish current for lights within 30 days.

TURLOCK, CAL.—The Yosemite Power Company has finished work upon the light and power line to the town of Denair, and is now ready to furnish both light and power to the residents of that part of Stanislaus county.

BREMERTON, WASH.—The city council of Bremerton, Washington, has passed a resolution calling for the purchase of the property belonging to the Bremerton-Charleston Light & Fuel Company with a view to making a municipal plant of same.

SAN FRANCISCO, CAL.—Two light rate ordinances formulated by the supervisors' light committee have been passed to print. They cover a 75c maximum charge for each 1000 cu. ft. of gas consumed and a 6c per kilowatt-hour electric lighting rate.

ALBANY, ORE.—A franchise for a gas plant in Albany has been granted C. L. Rauch of Portland. Rauch represents capitalists of Portland and Detroit, Mich. He must file a bond of $5000 to begin work before January 1, 1914, and have the plant in complete operation before December 31, 1914. The franchise runs for a period of 20 years, at which time the city has the option of buying the plant.

OAKLAND, CAL.—The board of trustees of Piedmont took the initial step at a recent meeting toward providing a municipal lighting system with underground wires. A report on the cost of the proposed system was submitted by City Engineer E. C. Prather, showing that an underground system covering 11½ miles of streets in Piedmont, with arc lights, will cost $44,000, with $20,000 for poles and wires. A tungsten system, covering the city could be installed for $51,000, with poles and wires costing $22,500.

TRANSMISSION.

PORTLAND, ORE.—Plans for a substation and transformer house for the Northwestern Electric Company in the Albina district have been completed.

EVERETT, WASH.—The Pacific Northwest Traction Company has applied for a franchise to construct underground conduits and pole lines for transmission of electric current for power, heat and lighting.

OLYMPIA, WASH.—Millard Lemon and Wilbur B. Foshay, their heirs and assigns have been granted the right to operate electric lines for transmitting electrical energy for heat and power for public use with all necessary poles and other appurtenances along the highways of Olympia.

REDLANDS, CAL.—The city trustees are taking steps towards the construction of a $6000 power line by the city from the city limits to the pump plants of the municipal water system, to carry out a contract with the Southern Sierras Power Company to furnish power for operation of pumps at the well.

LEWISTON, IDAHO.—The United States Land Office at Lewiston, Idaho, has received word from the department of the interior that 7,370 acres of land on the Snake and Salmon Rivers in the Nez Perce national forest have been withdrawn for power purposes. It is estimated that 350,000 h.p. can be produced at the sites found on this land.

STOCKTON, CAL.—The First Federal Trust Company of San Francisco has recorded here a $10,000,000 trust deed given by the Oro Electric Corporation to cover the Oro Company's bond issue in the same amount of 6 per cent 40-year bonds. The filing of the trust deed in this county was made necessary by the recent acquisition of property here by the electric company.

SEATTLE, WASH.—Frank McKeen, electrical engineer, Seattle, is installing a 500 h.p. hydroelectric unit for the Mason County Power Company in the Olympic Mountains in the Hoods Canal District. The current is to be used in smelting ore from the mine of the Manganese Products Company situated about 10 miles above Lake Cushman. This is the initial installation of what is to be a 120,000 h.p. plant.

SAN FRANCISCO, CAL.—Commissioner Thelen presided at the hearing of the Pacific Gas & Electric Company's application for leave to issue $5,000,000 of its general and refunding bonds. From the evidence of M. H. Bridges and D. H. Foote it appears that since March 15 the company's construction at Lake Spaulding and elsewhere has been defrayed out of the earnings, short-time loans, etc., the proceeds of the recent debenture issue having been consumed. The total of such expenditures to date aggregate $1,767,488.14, being apportioned as follows: March $365,564; April, $582,000; May, $818,000. The balance of the proposed issue, $3,410,000 in bonds, is expected to cover the completion of the

South Yuba development, which includes the Lake Spaulding dam and reservoir. The Cordelia-San Rafael tower line is also to be taken care of out of these funds.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The Municipal Railway is now in operation from the ferry to the beach. The first car made the trip on Wednesday.

EVERETT, WASH.—The Everett Interurban, Everett, Washington, operated by the Northwest Traction Company, on account of increased business, has constructed an addition to its freight shed practically doubling its capacity.

SAN FRANCISCO, CAL.—The state board of harbor commissioners will furnish all the terminals for municipal, United Railroads, or any other corporation that will build a line of elevated roads to the fair grounds. If the city does not make some move the state will within 60 days go ahead with its plans to bridge Market street.

TULARE, CAL.—Signalizing the completion of the Big Four railroad grading over the first section of the work from Tulare to Woodville, a distance of seventeen miles, the directors of the road met here and let the contract for furnishing steel rails for the system. Grading crews have been moved from this city to Woodville, and work will be started forthwith on the completion of the line to Poplar. When steel is laid on this latter section construction will be pushed on to Porterville. It will be the purpose of the directors to start cars running as rapidly as the various blocks of the work are completed.

SAN FRANCISCO, CAL.—Rights of way to the Sacramento Valley Electric Roalroad with terminal properties at Solano City at the head of the new tidewater canal have been granted by the Solano Irrigated Farms Company. The new road will cross the Oakland, Antioch and Eastern, with which traffic arrangements have been made for direct shipments to bay cities. Construction of the first thirty-five miles of single track to Woodland will begin in three months. Permission for a six million dollar bond issue will be asked of the Railroad Commission, and of this $750,000 will be expended on the first unit of the line. Later the road will be extended up the Sacramento Valley to Red Bluff, a distance of 195 miles.

SAN FRANCISCO, CAL.—The public utilities committee of the supervisors has decided to recommend to the board that the term for the redemption of the municipal railway bonds be fixed at 35 years, the intention being to annually pay off $100,000 of the proposed bonded indebtedness of $3,500,000. Redemption will not begin until five years after the date of the bonds, so that 40 years from the time of issue will elapse before the last of the bonds is redeemed. The committee has concluded to omit the provision giving the city the right to redeem the bonds after 20 years, believing that this would militate against their sale. Fifty-five per cent of the bonds are to be of $1000 denomination, 30 per cent $500 and 15 per cent $100.

FRESNO, CAL.—A change has been made in the route of the Fresno Traction Company's proposed line to the San Joaquin River. According to the new route, the line will turn east just before reaching the Riverside Country Club, and run along the top of the bluff for some distance, which will involve an extra expenditure of about $25,000. Officials of the company have signed a contract providing for the building of the line along the bluffs of the river. Chris P. Jensen, the engineer who is surveying the pipe line and compiling the maps, is rushing work on the data to be furnished the state railroad commission, and it is expected that the Fresno Traction Company will be in a position to apply to the commission for permission to build within the next week or ten days. The company is ready to start work in the early part of July. Material for the new line has already been ordered and is said to be on its way.

TELEPHONE AND TELEGRAPH.

DEMING, N. M.—The Mountain States Telephone & Telegraph Company is pushing to completion the new telephone system for the town.

PORTLAND, ORE.—Plans are being made for an eleven story and basement class A building for the Pacific Telephone & Telegraph Company, at an estimated cost of $300,000.

SEATTLE, WASH.—The new tariffs of the Pacific States Telephone & Telegraph Company for Washington have been filed with the public service commission. These tariffs cover practically every point in the state and the new rates are figured on the air line basis irrespective of the actual wire mileage used. For the first minute there is a charge of one-half cent a mile plus a five per cent terminal charge. The rate for additional minutes is one-half the first minute rate and all amounts are figured on multiples of five cents. It is presumed by the commission that the new tariffs will increase rates but it will take several weeks for communities to check up on same. It is thought however that objections will arise calling for investigation by the commission. The rates go into effect July 16.

WATERWORKS.

BURLINGAME, CAL.—The Trustees passed an order to advertise for bids for the construction of a municipal water plant in this city.

SAWTELLE, CAL.—The Santa Monica Water Company has applied for a franchise to lay pipes through the streets and alleys of Sawtelle.

BANDON, ORE.—By an overwhelming majority the voters of Bandon voted to reject the proposition for the city to purchase the Bandon waterworks for $62,000.

EL MONTE, CAL.—Engineer Brawner has filed a report of his investigation of the present water system, and estimates the cost of installing a new plant such as required for fire protection, also the purchase of the present plant, at about $20,000.

SAN FRANCISCO, CAL.—The supervisors have passed to print the new water rate ordinance, which contains the same schedule of charges now in force except for reductions in the prices provided for water furnished to shipping and for that supplied to contractors.

VALLEJO, CAL.—It has been announced that $55,000 on improvements at Mare Island will be the first money used under the new appropriation, available July 1. This will include a $25,000 salt water flushing and fire protection system and $20,000 for repairs on the seawall.

SAN BERNARDINO, CAL.—A deed, transferring the holdings of the Riverside Water Company in this county to Riverside, has been filed with County Recorder Allison. The consideration named is $575,000. Included in the property are numerous tracts of water bearing lands, pipe lines, canals and pumping plants.

VICTORIA, B. C.—Active work on the prosecution of the Sooke Lake development scheme will soon be commenced by the city under the supervision of Water Commissioner Rust, and bids will be called for an early date. The estimated cost of the materials is between $400,000 and $500,000 for the concrete pipe and $300,000 and $400,000 for the steel pipe. The concrete pipe will be used for the flow line, which will connect Sooke Lake with the proposed reservoir at Humpback, and between the reservoir and the city the steel pipe will be used for the pressure line.

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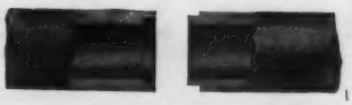

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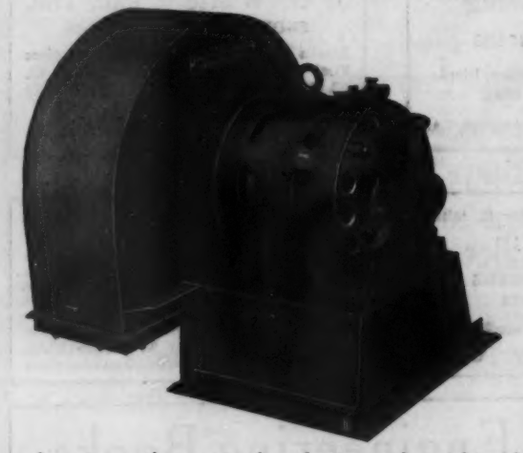

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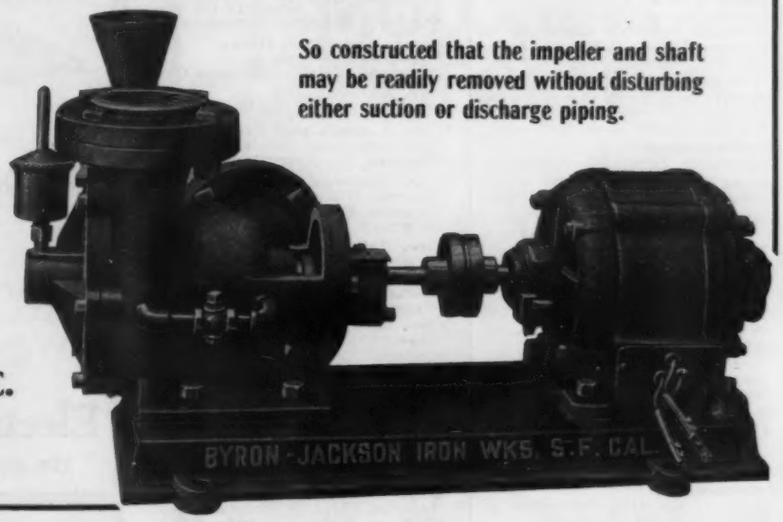

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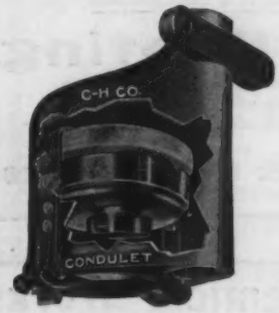

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147 to 151 Minna Street, San Francisco. Phone Kearny 806

Uniform Tension

O-B Trolley Base

(Patent Applied For)

Service tests show remarkably small variation in tension for different positions of pole.

Only slight increase in tension when passing under low trolley wire.

Will operate satisfactorily at high spots of trolley without necessitating an excessive tension under normal conditions.

Other features which have caused favorable comment are as follows:

Free rotating action.

Caged roller bearings — easily handled.

Buffing spring decreases shock on pole when wheel jumps.

Weight only 108 pounds.

See Pages 388-389 of Catalog 12

Holabird-Reynolds Co.

San Francisco and Los Angeles

California Agents For

The Ohio Brass Co.

Mansfield, Ohio

What one of Our many customers says about

DEPENDABLE DELIVERIES of MOLONEY TRANSFORMERS

Moloney Electric Co.,
Rialto Building,
San Francisco, Cal.:

Gentlemen:

About the 1st of November we were in the market for 375 k.w., 11,000 volt, 60 cycle, oil filled, self cooled transformers, and which we were in a great hurry for.

We took the matter of furnishing them up with several Electric Companies, yourselves included. Some companies wanting 6-8 weeks delivery at the factory in the East and to that the time of getting them out here had to be added, and when your Company named a delivery in San Francisco of 20 days, we did not think you could possibly make good in your offer, but as your time was so much below the other makers, we decided, all other considerations being out of the question, that we would place the order with you.

We gave you the order for the transformers on November 5th, and as shown by bill of lading you shipped them from your factory on November 13th, and they were delivered to us in San Francisco on November 23rd, or 18 days from receipt of the order, and we wish to express our appreciation of your prompt execution of this order.

The matter was of a good deal of importance to us and your making good on the delivery allowed us to meet a business engagement which we could not have otherwise done.

Thanking you for your prompt and satisfactory execution of this order and with a promise that should we be in the market again for goods in your line you shall have every consideration in getting such business as we may have, we remain,

Very truly yours,

We are enabled to make quick, dependable deliveries, because we are specialists in transformers.

Burnouts from any cause whatever during season 1911-12 less than ¼ of 1%

MOLONEY ELECTRIC CO.

Works: St. Louis, U. S. A. and Windsor, Canada

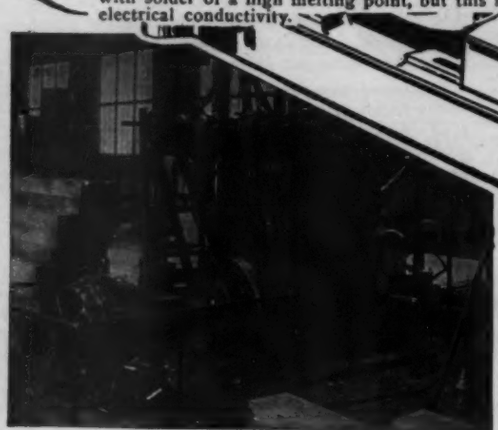
San Francisco Office, Rialto Building
Chicago Office - - 528 McCormick Building
Cincinnati Office. 608 First National Bank Bldg.

Central Station Managers

An important factor in the increase of your commercial day load will be your success in finding a motor to meet the requirements of your customers.

ALLIS-CHALMERS INDUCTION MOTORS

meet every requisite of continuously efficient performance. Reliability is assured by three important features: Rugged open box frame, thorough forced ventilation and rotor construction of special design in which the copper bars and the copper discs forming the end rings are joined to make a perfect electrical and mechanical union. In order to prevent any possible deterioration due to corrosion, the joint is thoroughly covered with solder of a high melting point, but this solder is not depended upon for either mechanical strength or electrical conductivity.



All details of construction in Bulletin 1081.

Write for it.

ALLIS-CHALMERS COMPANY Milwaukee, Wis.

First Departure—

SUNSET LIMITED

Train de Luxe

Winter Season 1913

From San Francisco (Third St. Station) 6:00 p. m. January 7th
From Los Angeles 8:15 a. m. January 8th
Arrives New Orleans 7:20 p. m. January 10th

A Once-a-Week Extra Fare Train

With every comfort and convenience for travelers, including:

Barber Shop	Ladies' Maid	Stenographer
Shower Bath	Manicuring	Stock Reports
Valet Service	Hairdressing	Buffet

Will leave San Francisco on Tuesdays, Los Angeles on Wednesdays, and save 24 hours in running time to New Orleans.

Observation-Clubroom Car with Ladies Parlor and Library. Compartment Car. Two Standard Drawing-room Sleeping Cars, providing Three-Room Suites if desired. Dining car service unexcelled.

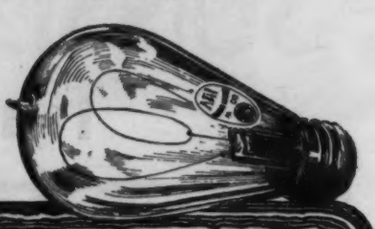
The route through the South is most interesting and delightful, and particularly enjoyable at this season.

Close Connection at New Orleans with fast trains to Eastern cities: also with Southern Pacific's commodious Atlantic steamers sailing to New York on Saturdays and Wednesdays.

SOUTHERN PACIFIC

SAN FRANCISCO: Flood Building. Palace Hotel. Ferry Station. Phone Kearny 3160
Third and Townsend Street Station., Phone Kearney 180
OAKLAND: Thirteenth and Broadway., Phone Oakland 162
Sixteenth Street Station., Phone Oakland 1458

Popular Magazine Advertising



Use 3 lights at the old cost of One

For the same money that you now pay for current for the old-style carbon lamp, you can have your choice of

3 times as much light in each room—or
3 times as many rooms lighted—or
3 times as many hours of light

if, instead of the carbon lamp, you use

Edison Mazda Lamps

Do you know the difference between the Edison Mazda Lamp and the old-style carbon lamp?

Look at the pictures. Note the difference in internal construction of these two kinds of lamps. Then look at *your* lamp. Which kind are you using?

Your nearest electrical dealer or lighting company will gladly show you the various sizes of Edison Mazda Lamps.

General Electric Company

Largest Electrical Manufacturer in the World
Sales Offices in all Large Cities. Agencies Everywhere

This Symbol on all Edison Mazda Cartons

The Guarantee of Excellence on Goods Electrical

3893

This is the reproduction of our advertisement as it will appear in the popular magazines in January

General Electric Company

Largest Electrical Manufacturer in the World

Edison Lamp Department 3893 **Harrison, New Jersey**

Popular Magazine Advertising

Another Seven Million Advertisements of Edison Mazda Lamps

The facing page advertisement will appear in 7,000,000 January copies of nationally-read magazines like the Saturday Evening Post, Literary Digest, Cosmopolitan, Everybody's, System and others. A similar advertisement in colors appears on the back cover of Collier's Weekly, Dec. 28th.

To realize the greatest profit from this advertising, you should emphasize locally the same ideas we are advertising nationally---and at the same time.

General Electric Company

Largest Electrical Manufacturer in the World

Edison Lamp Department 3933 Harrison, New Jersey

Standard Underground Cable Co.

MANUFACTURERS OF

Colonial Copper Clad and *Copper Wires* and *Cables* for Every Electrical Service *Open Air* and *Station Terminals* for all Voltages. *Junction Boxes, Insulating Compounds, Tapes* and other *Accessories.*

PACIFIC COAST DEPT. First National Bank Building, San Francisco

Sub-Office—Los Angeles, Cal., Seattle, Wash., Portland, Ore.

GENERAL OFFICES: PITTSBURG, PA.

Factories: Oakland, Cal., Pittsburg, Pa., Perth Amboy, N. J.
Branch Offices: New York, Boston, Philadelphia, Chicago, St. Louis, Atlanta
For Canada: Standard Underground Cable Co., of Canada, Ltd., Hamilton, Ont.

Large Stocks of all Standard Material Carried at our Oakland, Cal., Factory

Write for Descriptive Literature and Prices

OKONITE WIRE

OKONITE TRADE MARK REG. U. S. PAT. OFFICE

The STANDARD for RUBBER INSULATION

Okonite Tape, Manson Tape, Candee Weatherproof Wire, Candee (Patented) Potheads.

The Okonite Company

253 BROADWAY, NEW YORK

CENTRAL ELECTRIC CO., Chicago, Ill., General Western Agents
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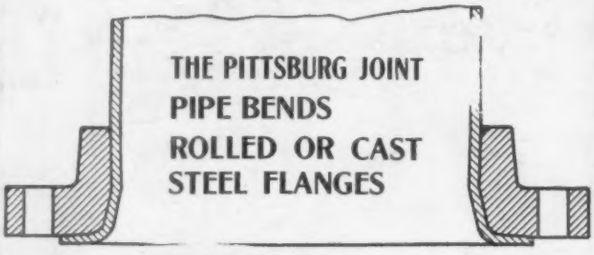
F. D. LAWRENCE ELECTRIC CO., Cincinnati, O

Pittsburg Piping and Equipment Co.

Piping Engineers and Contractors

PITTSBURG, PA.



THEO F. DREDGE

Pacific Coast Representative
Monadnock Bldg., San Francisco

Here is Something Needed

Needed by every Electrician, Electrical Mechanic, Lineman, Signalman, Installer, Repairman, Inspector,

TOOL KIT CONTAINING 7 TOOLS,

each one of superior quality. They are: Klein's 7-inch side-cutting pliers; 4½-inch nickle-plated tweezers; 5-inch nickle-plated scissors; double-bladed knife, screw-driver and wire-scraper combined; 8-inch half-round mill file; "Champion" screw-driver and 2-foot boxwood rule.

If your jobber cannot supply you, write us.

MATHIAS KLEIN & SONS
Canal Station Chicago, Ill.

Neat Economical Clean

SIMPLEX ELECTRIC TOASTERS

Use least current for the same work.

The only toasters that do not curl the slices or scatter the crumbs.

The "Keep-Hot" racks increase their capacity.

Removable doors confine the heat and assist cleaning.

Heavy nickel or silver plated — black enamel base — ornament to the finest table.

Made of brass and iron — will wear indefintely — cost reasonable. Write for Folders, Display Cards, etc.

The "Breakfast Table" Coffee Pot holds two full pints A rapid and efficient electric percolator, 100-120 volts, 440 watts. The automatic cutout prevents burning out, and

SIMPLEX QUALITY emphasizes

Simplex Electric Heating Co.

612 Howard Street, San Francisco

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TRADE MARK

BX CABLE

The time and money saving features of BX Cable should appeal to every contractor and jobber. Unusual flexibility is combined with great mechanical strength, making the wiring of new or existing buildings a comparatively easy and inexpensive undertaking.

Ask for Conduit Catalogue No. 43654

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OF GENERAL ELECTRIC COMPANY

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